

**METHODS FOR FORMING ROUGH RUTHENIUM-CONTAINING
LAYERS AND STRUCTURES/METHODS USING SAME**

Abstract of the Invention

5 A method for forming a rough ruthenium-containing layer on the surface of a
substrate assembly includes providing a ruthenium-containing precursor into the
reaction chamber. A rough ruthenium layer may be deposited on the surface of the
substrate assembly at a rate of about 100 Å/minute to about 500 Å/minute using the
ruthenium-containing precursor. Further, a rough ruthenium oxide layer may be formed
10 by providing a ruthenium-containing precursor and an oxygen-containing precursor into
the reaction chamber to deposit the rough ruthenium oxide layer on the surface of the
substrate assembly at a rate of about 100 Å/minute to about 1200 Å/minute. An anneal
of the layers may be performed to further increase the roughness. In addition,
conductive structures including a rough ruthenium layer or a rough ruthenium oxide
15 layer are provided. Such layers may be used in conjunction with non-rough ruthenium
and/or non-rough ruthenium oxide layers to form conductive structures. For example,
such structures may be part of a capacitor structure, e.g., bottom electrode of a
capacitor.

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